modulated light beam. In another aspect, the invention provides for an optical wireless link. The optical wireless link includes a photodetector configured to receive a modulated light beam conveying data. The optical wireless link also includes a control circuit coupled to the photodetector, the control circuit receiving the data conveyed by the modulated light beam, and extracting therefrom embedded control information. The optical wireless link further includes a processor coupled to the detector and receiving therefrom the control information and generating in response thereto beam alignment signals. Additional features of the optical wireless link include a beam transmitter coupled to the processor and receiving therefrom the beam alignment signals, the beam transmitter adjusting alignment of a light beam in response to the beam alignment signals. --

Please replace the paragraph beginning at page 9, line 6 with the following rewritten paragraph:

A2

-- OWL 4 communicates with OWL 6 over a collimated light beam 16. OWL 4 has a field of view 18 and the receiver of OWL 6 must be positioned within the field of view 18 for effective communication. Likewise, OWL 6 has a field of view 22 in which it can transmit a collimated light beam 20 to the receiver of OWL 4. As described in greater detail in co-pending patent application 09/620,943, signal to noise ration (SNR) is maximized when the light beams 16, 20 are centered on the photo-receivers of the receiving units 6, 4, respectively. The alignment of the light beam can be detected as a function of received optical power, signal intensity, and the like and this detected alignment information can then be fed back to the transmitter. Also described in greater detail in co-pending patent application 09/620,943 is a preferred embodiment mechanism for controllably steering the light beam. In addition to transmitting data to or from data from data source / sink 8, OWL 6 transmits the light beam alignment feedback signals to OWL 4 over light beam 20. Likewise, OWL 4 transmits beam alignment feedback signals to OWL 6 over its light beam 16, in addition to data to or from data source / sink 2. Because light beams 16, 20 are high bandwidth, low latency paths, the transmission of feedback signals over the beams allows for rapid alignment of the beams (low latency) without degrading the data handling capabilities of the system (high bandwidth). In the preferred embodiments, OWL devices 4 and 6 communicate with each other using standard 100

Mb/s Ethernet protocol. The inventive concepts described herein apply equally to other communication protocols, including ATM, TCP/IP, SONET, IEEE 1394, IRDA, 10 Mb/s Ethernet, Gigabit Ethernet, and other alternatives that will be within the purview of one skilled in the art. --

Please replace the paragraph beginning at page 10, line 3, with the following rewritten paragraph:

a3

-- Figure 2 provides further details for OWL 4. The following discussion applies equally to OWL 6. Data originating from data source / sink 2 and coming in over data connection 12 is received by PHY 24 where the data is converted from a serial format to a four bit parallel (MII) format, as is well known in the art. PHY 24 is a physical format converter that receives data in the format particular to the physical data connection to which it is attached and converts it into a media independent interface (MII) format that is not specific to a physical connection. From PHY 24, the data is passed to control logic 26 where the data may be encoded or decoded, supplemented with Operation / Administration / Maintenance (OAM) data, formatted for further transmission, enclosed within an appropriate network packet, or other data handling as is well known in the art. In addition, control logic 26 will read from the data stream certain control packets for light beam alignment, as will be discussed in greater detail below. A second PHY device 28 receives the data from control logic 26 and converts is from the parallel MII format into a serial format specific to optical data transmission. In the preferred embodiments, PHY 28 converts the data to a standard physical layer protocol for fiber optic transmissions (e.g., 100Base-FX or SX). Other physical layer protocols, or a specialized optical wireless protocol could also be used. The data is then passed to optical module 30, where it is converted from an electrical format to an optical format and transmitted over light beam 16 to OWL 6, from where it will be transmitted to the appropriate destination such as data sink / source 8 by way of data connection 14. --

Please replace the paragraph beginning at page 10, line 26, with the following rewritten paragraph:

-- OWL 4 operates as a receiver as well, in which case the data path is the opposite of that just described. Data from data sink / source 8 is processed by OWL 6 in the manner described above and transmitted optically to OWL 4 via modulated light beam 20. Optical module 30 detects the modulated light beam, converts it to an electrical signal, and passes the electrical signal to control logic 26 via PHY 28. Control logic 6 inspects the incoming signal and reads from it any control packets relating to beam alignment feedback, as discussed in greater detail below. The data stream is passed from control logic 26 to PHY 24 where it is converted to the appropriate physical format for transmission to data sink / source 2 over data connection 12. --

a4

Please replace the paragraph beginning at page 16, line 8, with the following rewritten paragraph:

-- A preferred arrangement of the data field 68, i.e. the actual control data, is provided in Figure 6a. The 38 byte field is logically divided into a twelve byte MCU Header 70 that contains the physical addresses of the two units (i.e. the sending unit and the receiving unit) and a 26 byte Servo Header 72 that contains the control signals. Figure 6b provides further detail regarding the logical organization of data field 68. As shown, the field contains two six bit fields, 74, 76, defining the physical address of the sending unit and the receiving unit, respectively. These comprise the MCU Header. The Servo Header comprises thirteen two-byte fields, including control field 78 and a two byte status field 80, which indicates the current mode of the OWL unit, such as seeking or tracking. The Servo Header also includes a sample field 80 that identifies the particular sample for which feedback is being provided and a "Last Sample Seen" 82 that identifies the last sample that was fed back. These fields can be used by the receiving unit to "recreate" its mirror position at the time the other unit last received a good optical signal. The "Time Stamp" field 84 also aids in this regard, and can be used by the receiving unit to "recreate" its mirror position at some previous point in time relative to the time stamp. The x and y coordinates of the light beam positioning for the sending unit is provided in the "My X" and "My Y" fields 88 and 90, respectively, and the x and y coordinates for the receiving unit are also sent in fields 92 and 94. This information ensures that the two devices

a5

have a common "understanding" of their relative positions to each other. Finally, four alignment parameters "Quad Position X," "Quad Position Y," "Quad Sum X," and "Quad Sum Y" are also transmitted in fields 96, 98, 100, and 102, respectively. These parameters, which are used by the receiving unit to better align its beam position are described in greater detail in co-pending, commonly assigned provisional patent application 60/285,461, filed April 20, 2001, entitled "Method and Apparatus for Aligning Optical Wireless Links," which patent application is incorporated herein by reference. --

Please replace the paragraph beginning at page 19, line 3, with the following rewritten paragraph:

a6

-- The OTU 324 can also be of conventional design. For example, a TTC-2C13 available from TrueLight Corporation of Taiwan, R.O.C., provides an advantageous and low cost optical transceiver unit, requiring only a single +5V power supply, consuming low power, and providing high bandwidth. However, it should be noted that OTU units of conventional design can provide less than optimal performance, since such units are typically designed for transmitting and receiving light from fibers. This results in three problems that should be noted by the designer. First, light is contained in such units and is thus not subject to the same eye safety considerations as open air optical systems such as the present invention. Consequently, such units may have excessively high power. Second, light is transmitted to a fiber and thus has optical requirements that are different from those where collimation is required, as in embodiments of the present invention. Third, light is received by such units from a narrow fiber, and therefore such units usually have smaller detector areas than desired for embodiments of the present invention. Accordingly, it is considered preferable to assemble a transceiver having a photodiode and optical design such that the maximum amount of light is collected from a given field of view. This requires as large a photodiode as possible, with the upper limit being influenced by factors such as photodiode speed and cost. In any event, a preferred light source is a vertical cavity surface emitting laser, sometimes referred to as a VCSEL laser diode. Such laser diodes have, advantageously,

a substantially circular cross-section emission beam, a narrow emission cone and less dependence on temperature. --

Please replace the paragraph beginning at page 20, line 23, with the following rewritten paragraph:

a7

-- For optical wireless links across large distances where the highest possible optical power density at the receiver is needed for robust transmission, the optical portion of the preferred embodiments should preferably be selected to achieve a divergence of less than 0.5 mrad, which is to be contrasted with the prior art systems that have divergences in the range of 2.5 mrad. The divergence of less than 0.5 mrad results in an optical density greater than 25 times the optical density of the prior art systems, which, for the same received optical power density corresponds to 5 or more times longer range. --

Please replace the paragraph beginning at page 23, line 9, with the following rewritten paragraph:

a8

-- In an alternative embodiment, the alignment information can be fed back to the transmitting unit in other ways than as a separate control packet. For instance, in one embodiment, the alignment information can be imposed upon the optical beam itself using low frequency, small signal modulation. Such an embodiment is illustrated in Figure 8. This embodiment takes advantage of the fact that optical communications generally use encoding schemes (such as 4B/5B encoding) that do not generate frequencies below a certain range. The low frequency bandwidth is therefore available for transferring low bandwidth data without interfering with the link data. The amplitude of the control data modulation needs to be a small fraction of the overall signal amplitude, or else the main data path signal to noise ration will decrease significantly. The control data could be encoded / decoded directly by the DSP 42.